

Exchanges Between the N. Pacific Ocean and Its Marginal Seas

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LONG-TERM GOALS

It is the long-term goal of the principal investigators of this grant to better understand the circulation of the N. Pacific Ocean and its marginal seas, especially the flow and water masses in the thermocline and above.

OBJECTIVES

The objectives of this work are to examine measurements collected in recent years in the western N. Pacific and its marginal seas (Japan Sea, Okhotsk Sea, Bering Sea), and CTD profiles collected from Argo floats, in the context of the NRL high-resolution model of the N. Pacific. We are especially interested in examining the production and spreading of North Pacific Intermediate Water (NPIW) in both the model and the data.

APPROACH

We are in continuous process of compiling all CTD and float data from the western N. Pacific that has been collected in recent years in order to have the best dataset possible for model comparison. This includes adding daily updates from the Argo array. The NRL model is being run at high resolution (1/12 degree), with the present run approximately 20 years in length. We are presently carrying out the best comparison of the data and model that can be done, focusing the comparison on the origins, circulation, and T/S properties of NPIW. The model includes both the Japan Sea and Okhotsk Sea, so it is possible to examine NPIW origins in some detail.

WORK COMPLETED

At this time, the model has been run for about 20 years in a high resolution mode. Sections of salinity and temperature from the model along 153.92 °E are shown in Figure 1. The subsurface salinity minimum indicative of NPIW can be seen at depths around 500 m. This is approximately the correct depth for NPIW in this region, and the values of salinity are plausible. We are in the process of comparing these model results to temperature and salinity profiles from UW floats in the Japan and Okhotsk Sea, and Argo floats, in the western N. Pacific, as shown in Figure 2.

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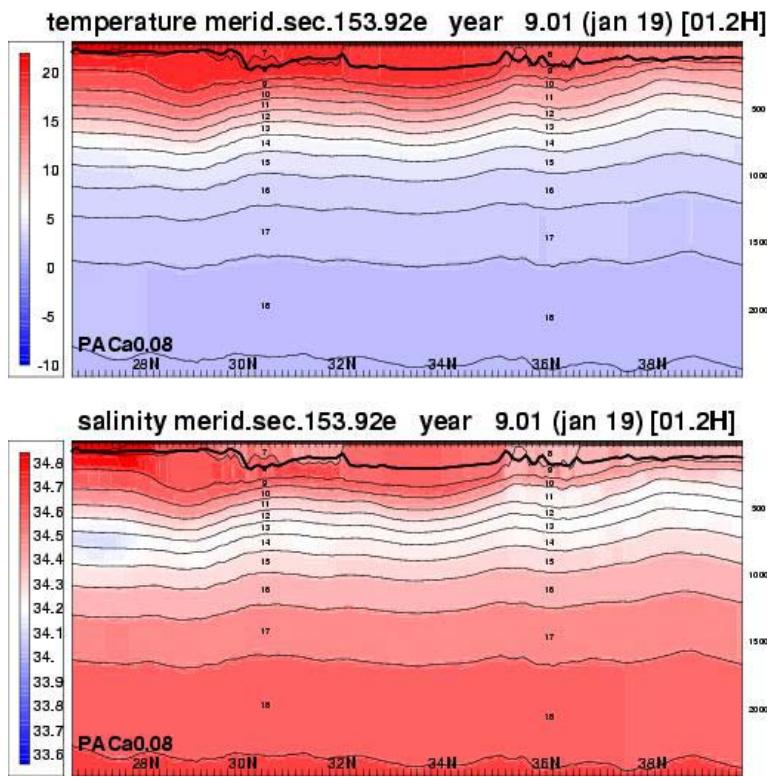


Figure 1. Temperature and salinity on 153.92 °E in the N. Pacific from the NRL high resolution HYCOM model.

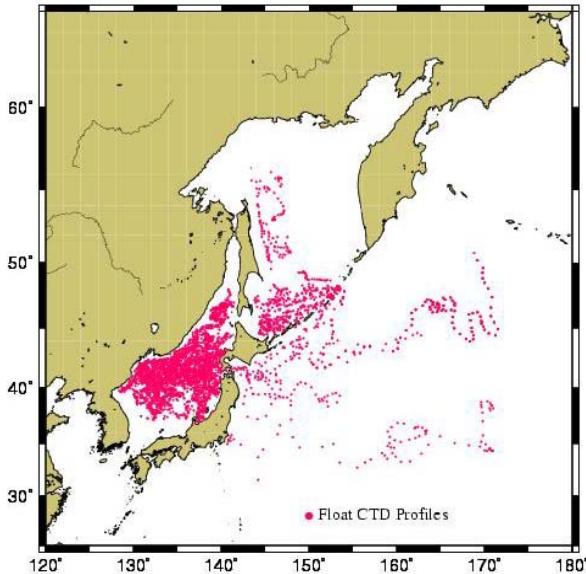


Figure 2. Positions of profiles from UW profiling floats in the western N. Pacific.

RESULTS

We have so far assembled the requisite data sets (both UW floats and all Argo floats) and WOCE CTD sections in the western N. Pacific, as well as CTD data collected in the Okhotsk Sea and Japan Sea in recent years. Additionally, the NRL HYCOM model continues to be run in order to increase the length of the simulation. The model-data comparisons are underway and should be concluded, with publications produced, by the end of calendar 2005. Additionally, we have carried out several studies of the temperature/salinity properties of the NW Pacific and the Okhotsk Sea using profiling float data alone and with historical Japanese data.

IMPACT/APPLICATIONS

We hope to be able to discern the details of marginal seas/N. Pacific interactions from our study, especially mixing and formation of water masses near the marginal sea straits. A graduate student is working on this project, and is using the results for a PhD dissertation. The student has recently passed her departmental general examination and will likely finish her dissertation, with final results from this project included, in the second half of 2007.

RELATED PROJECTS

This work is closely tied to the analysis of Argo float data from the Pacific. In this project we are using all Argo data in the NW Pacific, along with float data from the Japan and Okhotsk Seas, to understand the interaction of these marginal seas with the N. Pacific. Using Argo data and WOCE CTD data, we have found large-scale changes in the subsurface salinity field of the N. Pacific that have occurred between the WOCE era (1985-1993) and the Argo period (2002-2005). It appears that these changes are at least partially related to decade-scale variability in the marginal seas over this period. Other effects contributing to these changes in salinity include large-scale changes in precipitation and evaporation over the Pacific and changes in sea ice cover in the Antarctic.

In the process of carrying out these analyses, we have found that the CTD data base in winter for the extreme northwest Pacific is rather poor. In order to remedy this problem, we have targeted 10 Argo floats for deployment in the northwest Pacific in the region between the western Aleutians and the Kamchatka peninsula (at no cost to this grant). The data from these floats should be very helpful in augmenting the wintertime data base from this region and should aid in the analyses being carried out in this project. As of this writing, 7 of these floats have been deployed. All were deployed from NAVO C-130 aircraft operating in the NW Pacific region. We gratefully acknowledge the help we have received from NAVO in this work.

PUBLICATIONS

Ohshima, K., S. Riser, and M. Wakatsuchi (2005) Mixed layer evolution in the Sea of Okhotsk observed with profiling floats and its relation to sea ice formation. *Geophysical Research Letters*, 32, L06607, doi:10.1029/2004GRL021823, 2005 [published, refereed]

Ren, L. and S. Riser (2006) Decadal changes in intermediate water mass properties in the Pacific Ocean. *EOS Transactions of the American Geophysical Union*, 87 (36), Ocean Sciences Meeting Supplement, Abstract OS43C-06.